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(4), to be finally inserted, broad and fleshy, into the sternal end of the first, second, and third ribs. Its total length is 9 inches.

4. *Intercostal muscle* (referred to above), . . . . . 0·01 oz.

Arises from the lower third of the sternum; and is inserted into the middle of the second rib.

5. *M. cremaster*, . . . . . 0·01 oz.  
6. *M. internus obliquus*, . . . . . 0·08 oz.

The Rev. SAMUEL HAUGHTON, M. D., Fellow of Trinity College, Dublin, read the following paper:—

#### NOTES ON ANIMAL MECHANICS.

##### NO. X.—MUSCULAR ANATOMY OF THE EMU (*Dromæus Novæ Hollandiæ*).

I AM indebted to the kindness of Mr. Thomas Moore, Curator of the Derby Museum, of Liverpool, for the opportunity of dissecting a fine male specimen of the Emu (*Dromæus Novæ Hollandiæ*). This bird was sent to me from London (1865); and, having reached Dublin two days after death, was quite fresh, and in fine condition for dissection. On inspection it presented tubercles of the liver (Farre's?), an enormous development of omental fat, and fibrinous clots, partly melanotic, in all its arteries.

I had also, through Professor Huxley, applied to the Council of the Zoological Society of London, for permission to dissect the muscles of the Ostrich, Emu, or Cassowary, in case such birds should die in their Gardens, and their bodies not be more favourably disposed of. In consequence of this application I received, 27th of April, 1866, the second Emu described in this note, which proved to be a larger and finer bird than the first; and I beg leave to take the present opportunity of returning my thanks to Professor Huxley, to Dr. Sclater, and to Dr. Murie, of the London Gardens, for the kindness with which they aided me in my attempt to procure specimens of these rare birds for the purposes of scientific research.

The examination of the muscles of these two Emus afforded the following results:—

##### A.—Muscles of the Hip Joint.

- |  |          |
|--|----------|
| 1. <i>M. psoas magnus</i> , . . . . .                              | none.    |
| 2. <i>M. iliacus</i> , . . . . .                                   | none.    |
| 3. <i>M. pectinæus</i> , . . . . .                                 | none.    |
| 4. <i>M. adductor brevis</i> , . . . . .                           | none.    |
| 5. <i>M. adductor magnus</i> (Fig. 28, <i>ad. mg.</i> ), . . . . . | 3·4      |
| „ . . . . .  | 5·2      |
|  | 4·30 oz. |

Takes its origin from the lower border of the ilium (postacetabular), and from the upper margin of the ischium, round the ischiadic foramen, and from the membrane of that foramen (*y*), Fig. 28, *ad. mg.* The greater part of this muscle  $\left\{ \begin{smallmatrix} 2.7 \\ 4.7 \end{smallmatrix} \right\}$  3.7 oz., is inserted by a strong flat tendon into the top of the linea aspera; and the rest is digastric (becoming tendinous as it passes behind the hip joint), and inserted into the linea aspera of the upper half of the thigh, as far down as the commencement of the *M. semi-membranoso accessorius*; it overlies the *adductor longus*.

6. *M. obturator externus*, . . . . . 1.4 } . . 1.55 oz.  
 ,, . . . . . 1.7 }

This muscle (which probably corresponds with the *obturator externus* of Mammals) arises from the *inner* surface of the bony rim of the ischiadic foramen (*y*), and its tendon passes with that of the *obturator internus* through the obturator tendinal foramen (*x*), and is inserted, after receiving the tendon of the *posterior gemellus*, No. 7, into the lower depression (Fig. 29. *o. e.*), marked on the outer side of the head of the femur.

7. *M. gemellus posterior*, . . . . . 0.15 } . . 0.18 oz.  
 ,, . . . . . 0.20 }

Origin very small, and near the acetabulum, from the outer side of the head of the obturator membrane (*z*). Both *gemelli* are found in the Emu; the *posterior* attaching itself to the tendon of the analogue of the *obturator externus*, and the *anterior* to the tendon of the true *obturator internus*.

8. *M. adductor longus*, . . . . . 2.1 } . . 2.75 oz.  
 ,, . . . . . 3.4 }

Arises from the lower border of the ischium (Fig. 28, *ad. l.*), below the inferior margin of the *adductor magnus*; and is inserted into the inner edge of the condyloid pit of the femur, and into the crucial ligament of the inner condyle. This muscle was originally double, and is folded on itself; its fibres were pale and fatty in both specimens.

9. *M. obturator internus*, . . . . . 2.5 } . . 2.90 oz.  
 ,, . . . . . 3.3 }

Arises from the inner side of the bony rim of the obturator foramen (*z*), and from its membrane, and is inserted (Fig. 29, *o. i.*) into the upper depression at the top of the back of the outer side of the head of the femur. The *anterior gemellus* is included in the weight of the *obturator internus*.

10. *M. agitator caudæ et tensor vaginæ femoris*, 11.9 } . . 15.35 oz.  
 ,, . . . . . 18.8 }

This combined muscle takes its origin by fascia, from the superior

edge of the ilium in front of the acetabular prominence (Fig. 28, *t. f. v.*), and from the superior post acetabular edge of the ilium by fleshy fibres (Fig. 28, *ag. cd.*); and is inserted into the strong fascia overlying the knee on its outer side, and by a fleshy union and common tendon with the *vastus externus*.

The pre-acetabular muscle (*t. f. v.*) weighs . 3·5 } . . 4·25 oz.  
and is inserted into the fascia of the knee, . 5·0 }

The post-acetabular muscle (*ag. c.*) weighs . 8·4 } . . 11·10 oz.  
" . . . 13·8 }

and passes directly into the tendon of the *vastus externus*.

Fig. 28.

*y*, Ischiadic foramen.      *z*, Obturator foramen.      *x*, Tendinal foramen.

11. *M. glutæus maximus*, . . . . . 1·0 } . . 0·95 oz.  
" . . . . . 0·9 }

The *gl. max.* takes its origin below that of the *ten. fem. vag.* and *agit. caudæ*, by fleshy fibres from a short space in front of and behind the acetabular prominence of the ilium (Fig. 28, *gl. max.*).

12. *M. glutæus medius*, . . . . . 5·1 } . . 5·65 oz.  
" . . . . . 6·2 }

The origin and insertion of this muscle are marked in Figs. 28, 29—*gl. md.*

13. *M. glutæus minimus*, . . . . . 0·2 } . . 0·20 oz.  
" . . . . . 0·2 }

The origin and insertion of this muscle are marked in Figs. 28, 29, *gl. mn.*

14. *M. gluteus quartus (ilio-capsularis)*, . . 1·1 } . . 1·15 oz.  
 „ . . 1·2 }

Origin and insertion marked in Figs. 28, 29, *il. cp.*

B. *Muscles of the Knee Joint.*

1. *M. biceps femoris*, . . . . . 9·4 } . . 10·90 oz.  
 „ . . . . . 12·4 }

Takes its origin from the large concave post-acetabular surface of the ilium, marked in Fig. 28; and is inserted by a round tendon passing through a looped pulley placed at the inner side of the outer head of *gastrocnemius* and outer condyle of the femur, into the large tubercle of the fibula, at its upper point of trisection.

Fig. 29.

2. *M. semimembranosus*, 4·4 } . . 5·80 oz.  
 „ 7·2 }

The *semimembranosus* arises from the posterior margin of the ilium, adjoining the ischium (Fig. 28, *s. m.*), and from the sides of the 1st, 2nd, and 3rd caudal vertebræ; and flows freely over the posterior margin of the ischium (*s. t.*), and is inserted by means of a pinnæform tendon (shown at *s. m.* and *ac.* Fig. 30) formed with the help of the *accessorius*, into a final flat tendon forming one of the heads ( $\beta$ ) of the *gastrocnemius*, on the inner side.

3. *M. semimembranosus-accessorius*, . . 0·6 } . . 0·70 oz.  
 „ . . 0·8 }

This muscle is shown in Fig. 30, *ac.*

Fig. 30.

Arising from the lower half of the *linea aspera*, and from the back of condyloid pit at the inner condyle, and inserted into the pinnæform tendon of the *semimembranosus*. It will be observed that the plane of the *semi. m.* lies exterior to those of the *semitendinosus* and *adductores magnus* and *longus*.

4. *M. semitendinosus*, . . . . . 1·0 } . . 1·40 oz.  
 ,, . . . . . 1·8 }

Arises from the posterior ends of the ischium and pubes (Figs. 28 and 30, *s. t.*), and terminates partly in a delicate tendon running into the tendon of the *plantaris*, and partly in a tendon inserted into the side of the tibia ( $1\frac{1}{2}$  inch down).

5. *M. gracilis* (A), . . . . . 1·0 } . . 1·45 oz.  
 ,, . . . . . 1·9 }  
 ,, (B), . . . . . 0·9 } . . 1·00 oz.  
 ,, . . . . . 1·1 }

There are two muscles in the Emu, neither of which are entitled to be regarded as *pectineus* or *adductor brevis*, and both present certain analogies with *gracilis*. I shall regard them as *gracilis* (A), and *gracilis* (B).

(A). Takes its origin from the anterior spine of the pubes, and a line two inches in length behind it on the pubes (Fig. 28, *gr.*); and is inserted by a line three inches long into the edge of the inner border of the *vastus internus* (1) at its lower extremity.

(B). This muscle is double headed; one head being supplied from the pubic bone, immediately behind the anterior spine; and the other head taking its origin from the upper inch of the *linea aspera* of the femur; the tendon of the united muscle is strong and flat, and is inserted into the inner side of the head of the tibia.

6. *M. sartorius*, . . . . . 6·2 } . . 7·80 oz.  
 ,, . . . . . 9·4 }

Its origin is marked Fig. 28, *s. s.*, and its insertion is made by a flat tendon into the inner side of the head of the tibia.

7. *M. rectus femoris* (Qu. *gracilis* (A) or (B)), . . . . . none.  
 8. *M. vastus externus*, No. 1, . . . . . 7·2 } . . 8·60 oz.  
 ,, . . . . . 10·0 }

Takes its origin all round the rim of *vastus externus* (2), which is completely covered by it, and from the surface of the outer front of the femur marked in Fig. 29, *v. e.* 1; and is inserted into the cartilaginous patella, like the ordinary *rectus femoris*, but rather towards the outer side.

9. *M. vastus externus*, No. 2, . . . . . 0·80 } . . 1·00 oz.  
 ,, . . . . . 1·20 }

Takes its origin from the surface marked on the outer side of the femur Fig. 29, *v. e.* 2; and is inserted by means of a strong tendon (passing

under the outer head of the *gastrocnemius*, and under the muscular head of the *flexor perforatus digiti interni*, and of the *flexor secundus perforatus digiti medii*), into the outer tubercle of the tibia. Its tendon of insertion passes over the muscular head of the *flexor perforatus digiti externi*.

10. *M. vastus internus*, No. 1, . . . . . 1·1 } . . 1·40 oz.  
 „ . . . . . 1·7 }

Has an origin similar to that in the Ostrich, and is inserted into the inner side of the cartilaginous patella.

11. *M. vastus internus*, No. 2, . . . . . 1·5 } . . 1·70 oz.  
 „ . . . . . 1·9 }

This muscle is composed of three distinct parts, occupying the lower, middle, and upper thirds of the femur on its inner aspect; these parts terminate in distinct tendons, which cross each other, the upper and lower passing to the lateral tubercle and head of tibia next inner condyle, while the middle tendon is attached between them to the tibia and to the fascia covering the patella.

12. *M. popliteus*, . . . . . 0·3 } . . 0·35 oz.  
 „ . . . . . 0·4 }

Inserted  $1\frac{1}{2}$  inches down tibia.

#### C. Muscles of the Heel and Foot.

1. *M. gastrocnemius*, . . . . . 24·4 } . . 28·00 oz.  
 „ . . . . . 31·6 }

This muscle consists of four distinct parts—

- a*, . . . . . 9·6 } . . 10·60 oz.  
 . . . . . 11·6 }  
*β*, . . . . . 1·2 } . . 1·35 oz.  
 . . . . . 1·5 }  
*γ*, . . . . . 1·1 } . . 1·25 oz.  
 . . . . . 1·4 }  
*δ*, . . . . . 12·5 } . . 14·80 oz.  
 . . . . . 17·1 }

Total, . . . . . 28·00 oz.

*a*. This portion takes its origin from the outer condyle (having behind its head the pulley through which the tendon of the *biceps* passes), and from the fascia covering the patella.

*β*. This part of the muscle is inseparably connected with the muscle accessory to the *semi-membranosus*; and, in a mechanical point of view, the *semi. memb.*, and its accessory muscle, aid the *gastrocnemius*, by their insertion into the head of (*β*), which arises from the inferior prolongation on the femur, of the line of origin of the *accessorius*.

γ. This branch of the *gastrocnemius* arises from the condyloid pit of the femur, by a beautiful round cord-like tendon.

δ. This arises from the whole inner side of the head of the tibia, and from the side of the patella.

2. <i>M. soleus</i> ,	. . . . .	10·0	} . 11·50 oz.
„	. . . . .	13·0	

Takes its origin from the anterior edge of the fibula, from the outer side of the tubercle of the tibia, from the whole outer surface of the ligamentum patellæ, and from the fascia covering the *tibialis anticus*. Its insertion is double; by a broad tendon into the *ligamentum calcis*, which acts as a patella to the heel, and by a narrower tendon, which, at six inches below the first insertion, is inserted into the outer side of the tendon of the first *flexor perforatus digiti medii*.

3. <i>M. plantaris</i> ,	. . . . .	0·30	} . . 0·26 oz.
„	. . . . .	0·21	

Arises from the back of the inner cartilage of the knee joint, and is inserted into the inner side of the *ligamentum calcis*, or patella of the heel.

N. B.—The tendon of this little muscle receives a large portion of the *semitendinosus*.

4. <i>M. flexor perforatus primus digiti medii</i> ,	. . . . .	1·8	} . . 2·45 oz.
„	. . . . .	3·1	

Arises by two heads, from the patellar fascia covering the outer condyle, and by a long tendon, terminating in the condyloid pit; and is inserted by a perforated tendon on both sides of the distal ends of the first phalanx of the middle toe.

The tendon of this muscle is united by means of a cross slip (intended to produce unity of action) with that of the next muscle, at a point opposite the metatarso-phalangeal articulation.

5. <i>M. flexor perforatus secundus digiti medii</i> ,	. . . . .	1·3	} . . 1·45 oz.
„	. . . . .	1·6	

Arises from the outer side of the ligamentum patellæ, overlying the tendon of *vastus externus* (2); and is inserted by a perforated tendon into both sides of the distal end of the second phalanx of the middle toe.

6. <i>M. flexor perforatus digiti externi</i> ,	. . . . .	1·3	} . . 1·45 oz.
„	. . . . .	1·6	

Arises, by a double head, from the external ligament of the knee joint, underlying the tendon of *vastus externus* (2), and from the condyloid pit; and is inserted by a perforate tendon into both sides of the distal end of the first phalanx of the outer toe.

N. B.—The tendon of this muscle, before it reaches the heel, passes through the tendon of the second perforate tendon of the middle toe, for a distance of three inches, as if in a sheath.



7. *M. flexor perforatus digiti interni*, . . . 0.15 }  
 ,, . . . 0.20 } . . . 0.18 oz.

This little muscle arises from the outer fascia of the knee joint, overlying the tendon of *vastus externus* (2), and is inserted at both sides of the distal end of the first phalanx of the inner toe.

8. *M. flexor hallucis longus*, . . . . . 0.4 }  
 ,, . . . . . 0.6 } . . . 1.00 oz.

Arises from the back of both heads of the *flexor perforatus* of the middle toe, and is inserted on the outer side of the near end of first phalanx of inner toe.

9. *M. flexor communis perforans*, . . . . . 2.4 }  
 ,, . . . . . 4.0 } . . . 3.20 oz.

This muscle is formed of two totally distinct muscles, whose separate tendons unite into a common tendon two-thirds down the cannon bone.

- a*, . . . . . 0.7 }  
 . . . . . 1.1 } . . . 0.90 oz.  
*β*, . . . . . 1.7 }  
 . . . . . 2.9 } . . . 2.30 oz.

Total, . . . . . 3.20 oz.

*a*. Arises by a double head from the backs of both condyles of the femur; its tendon passes through a sheath formed in the *ligamentum calcis*, on the outer side of the inferior ridge of the cannon bone.

*β*. Arises from the whole posterior surfaces of the tibia and fibula, except the portion of the tibia occupied by the *popliteus*.

N. B.—The united tendon of the *perforans* bifurcates, at the metatarso phalangeal articulation, to the ungual phalanges of all the toes, and at its point of bifurcation a small auxiliary muscle (0.05 oz.) unites the tendon with the posterior border of the sesamoid ligament, under the groove of which the common tendon passes.

10. *M. tibialis anticus*, . . . . . 4.6 }  
 ,, . . . . . 5.1 } . . . 4.85 oz.

This muscle is bicipital, and arises from the anterior and outer tubercles of the tibia and the surface of bony ridge joining them; and (as in the Dog and other animals) by a long, beautiful, round rope-like tendon, from the point of the outer condyle, inside the knee joint.

It is inserted into the near end of the cannon bone, in front of the heel, first passing under a "dead eye" ligamental bolt on the front of the tibia.

11. *M. extensor communis digitorum longus*, 1.2 }  
 ,, . . . . . 1.4 } . . . 1.30 oz.

Arises from the front of the tibia, on the outer side of the ridge running down from the anterior tubercle, and is inserted by tendons

distributed to the ungual phalanges of all the toes, and to the tendinous sheath of the first phalanx of the middle toe.

12. *Flexor digitorum brevis et abductor digiti*

*externi*, . . . . . 0·1 } . . 0·10 oz.  
 „ . . . . . 0·1 }

The *flexor brevis* arises from two inches of the outer and back surface of the near end of the cannon bone, and unites with the *abductor* by a long slender tendon running the whole length of the cannon bone; the *abductor* arises from the outer and under side of the distal end of that bone, for a space of  $1\frac{1}{2}$  inch, marked off by a slight bony ridge; and the common tendon is inserted into the outer side of the near end of the first phalanx of the outer toe.

13. *Abductor hallucis et extensor digitorum*

*brevis*, . . . . . 0·2 } . . 0·20 oz.  
 „ . . . . . 0·2 }

These muscles are inseparable; and the *abductor* arises from an inner surface of the under and distal end of the cannon bone, marked off by a slight bony ridge, like that of the *abductor minimi digiti*, while the *extensor* takes its origin by a thin sheet of muscular fibres from the whole breadth of the upper surface of the distal end of the cannon bone, for the space of one inch.

Fig. 31.

D.—*Muscles of the Wings.*

The anterior limbs in the Emu are much smaller than in the Ostrich and Rhea, and are hidden almost completely by the plumage. The following sketch (Fig. 31) gives a very good idea of the relative proportions of the bones of the wing and sternum; and in it, the initial letters indicate the parts.

1. *M. trapezius*,

0·27 }  
 0·28 } 0·28 oz.

Takes its origin from the first, second, and third ribs, and subcutaneously, from the skin covering them; and is inserted into the clavicle, acromion ridge, and anterior two-thirds of the scapula. Its posterior fibres slant forwards.

2. *M. rhomboideus*, . . . . . 0·12 }  
 „ . . . . . 0·11 } . . 0·12 oz.

Arises from the third rib, and space between it and second rib; and is inserted into the under surface of the posterior third of the scapula; its fibres slant backwards.

3. *M. latissimus dorsi et teres major*, . . . 0·13 }  
 „ . . . . . 0·15 } . . 0·14 oz.

Occupies its usual position, passing over the posterior border of the scapula, and has also a subcutaneous origin; the *lat. dorsi* arises from the fourth rib, and forms the posterior slip of the whole conjoined muscle; the *teres major* arises from the outer side of the posterior half of the scapula. These muscles are inserted by a common tendon into their usual place at the back of the humerus.

4. *M. pectoralis (major et minor)*, . . . . . 0·05 }  
 „ . . . . . 0·09 } . . 0·07 oz.

This sheet of muscle takes origin from the front and edge of the sternum and from the sternal ribs (two inches), and has the usual insertion; it is an *adductor humeri*.

5. *M. pectoralis secundus*, . . . . . 0·09  
 „ . . . . . 0·04 . . 0·065 oz.

Arises in a thin sheet from the lower border of the acromion, from the surface of the clavicle, and from the coraco-clavicular membrane, and terminates in a tendon passing over the groove in the upper end of the coracoid, to be inserted into the top of the pectoral ridge of the humerus;—it is a *levator humeri*.

6. *M. deltoideus*, . . . . . 0·05 }  
 „ . . . . . 0·08 } . . 0·065 oz.

Arises from the acromial end of the scapula, at the coraco scapular line of junction, and is inserted into the outer side of the pectoral ridge.

7. *M. coraco-brachialis*, . . . . . 0·05 oz.

Arises from the outer edge of the coracoid, and is inserted into the upper and inner fourth of the back of the humerus.

8. *M. triceps humeri*, . . . . . 0·05 }  
 „ . . . . . 0·08 } . . 0·065 oz.

Has three heads—

- α. cutaneous (*panniculus carnosus*).  
 β. long head from scapula in usual place.  
 γ. fleshy, from the inner and back side of the humerus.

9. *M. supra et infra spinatus*, . . . . . 0·01 }  
 „ . . . . . 0·01 } . . 0·01 oz.

Arises from one inch of the lower edge of scapula, close to glenoid, and

is inserted into the inner side of the back of the head of the humerus, in front of the insertion of the *subscapularis*.

10. *M. subscapularis*, . . . . . 0·01 } . . 0·01 oz.  
 „ . . . . . 0·01 }

Origin from the inner and lower border of the scapula, half an inch from glenoid; inserted into the top and back of the inner side of the head of the humerus, inside the insertion of the *spinati*.

10. *M. serratus magnus*, . . . . . 0·14 } . . 0·115 oz.  
 „ . . . . . 0·09 }

Arises from second and third ribs in the usual manner, and is inserted as usual.

11. *M. biceps humeri*, . . . . . 0·01 } . . 0·025 oz.  
 „ . . . . . 0·04 }

The Rev. SAMUEL HAUGHTON, M. D., Fellow of Trinity College, Dublin, read the following paper:—

#### NOTES ON ANIMAL MECHANICS.

##### NO. XI.—MUSCULAR ANATOMY OF THE RHEA (*Struthio Rhea*).

I AM indebted to Mr. Thomas Moore, Curator of the Derby Museum of Liverpool, for the opportunity of dissecting the Rhea, which forms the subject of this notice. It was a male bird, and seemed to be in good condition.

##### A.—Muscles of the Hip and Knee Joints.

1. *M. psoas magnus*, . . . . . none.  
 2. *M. iliacus*, . . . . . none.  
 3. *M. pectinæus*, . . . . . 0·12 oz.

Arises immediately in front of the acetabulum (Fig. 32, *p.*), and is inserted into the top of the linea aspera.

4. *M. adductor brevis*, . . . . . none.  
 5. *M. adductor magnus*, . . . . . 2·60 oz.

Arises from the lower border of the ilium, forming the upper margin of the ischiadic foramen, *y* (Fig. 32), and the prolongation of this bone backwards in conjunction with the ischium (Fig. 32, *ad. mg.*); it is partly inserted into the top of the linea aspera, and partly into the tendon of the *semimembranosus* that is attached to the femur; the tendinous slip that joins these muscles helps them both to pull on the same tendon at the back of the femur.